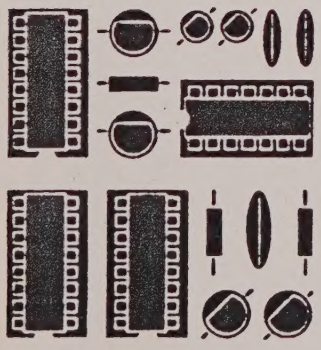
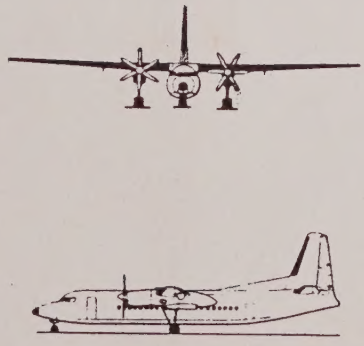
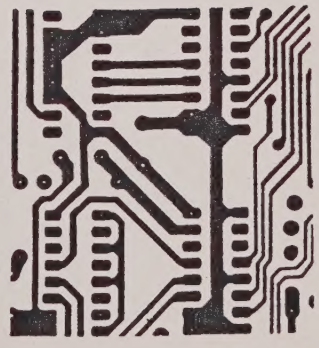
DDM 1001

DIGITAL DEVIATION
LOCALIZER TEST SET







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DDM 1001

TRANS-PORTABLE LOCALIZER DIGITAL DEVIATION METER

T A B L E O F C O N T E N T S

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1.1 PURPOSE

The DDM 1001 was designed for portable vehicular testing of localizer deviation including beam centering and scaloping.

1.2 EQUIPMENT SUPPLIED

- One DDM 1001
- One Case and Cover
- One Co-Ax 1.3 m.
- One Manual

1.3 FEATURES

Easily portable, the DDM 1001 weighs less than five kilogrammes and measures in millimetres 15.5 high, 20.5 wide and 30 long.

It is equipped with a folding, carrying handle and has a top-access viewing door for meter protection. Under this is found the Digital and Analog Deviation Meters and essential control switches. The case has a front removable door for access to VIR 351 controls. (Door may be removed for general usage, but must be attached for shipping).

The door also provides cable storage.

The DDM 1001 unit is easily removed from the carrying case for calibration purposes by detaching the 4 rubber feet on case bottom. A large calibration cut-out is provided for by easy access to the VIR 351 adjustments. (See Section 5.)

As supplied, the DDM 1001 is capable of providing Digital VOR TO/FROM bearing read-out.

Being designed around a Collins VIR 351 VOR Localized Receiver Convertor, the Unit is easily removable for service and calibration from the front of the DDM 1001 unit.

1.4 SPECIFICATIONS

(a) Receiver - The VIR 351 Receiver covers the frequency spectrum of 108.0 to 117.950 in .50 kc steps. N.B. for detailed characteristics, see Section 5.

(b) DDM - The Texmate PM-35A 3½ digit meter provides an accuracy $\mp$.05% reading +1 digit.

The DDM is switchable to read three functions, namely,

1) - Deviation (center, spring-loaded position) full scale reads 1999 m.v. which corresponds to uA localizer deviation.
2) Flag (same scale as in deviation).
3) AGC (corresponds to uA, but divided by ten).

2.1 OPERATION

Although the DDM 1001 controls are self-explanatory, here are a few tips on how to use this equipment.

a) Connect the Cigarette Lighter Plug to a suitable power source providing between +12V and 20 Volts. (Voltage lower than 12V may produce erroneous operation of the VIR 351 while voltage exceeding 20V may damage the equipment.)

b) Turn the VIR 351 Vol. Control/On Off switch to the "On" position and observe the illuminated frequency display and digital meter.

c) Select the proper operating frequency on the VIR 351 by turning the concentric knobs either clockwise to increase or counterclockwise to decrease the frequency. The larger knob will select the MHz while the smaller will select the fraction of MHz.

d) Connect the supplied coaxial cable to the front panel Ant. Jack and to a suitable Nav. Antenna.

e) Place the Analog Deviation Meter S2 in the 150UA or Low sensitivity everytime you start your test to avoid the posibility of overloading the meter movement.

f) Place the spring-loaded S1 switch in FLAG position and observe an approximative -300 display. Return the switch in DDM position.

g) When you are properly positioned on the runway, both analog and digital meter should read ZERO.

h) Place sensitivity switch S2 in 15UA position for scaloping test of the localizer beam. (Always return to the 150UA position when test is concluded.)

i) If you wish to listen to the Loc. Ident., pull the volume control knob to activate the Ident. switch and turn the control clockwise until the proper level is reached. Use this feature only for momentary listening and return the control to the minimum or counterclockwise position, since the audio has a slight effect on the VIR 351 deviation output.

j) Select AGC position whenever an AGC reading is needed. The Digital Meter will display something between -400 to -500 depending on signal strength.

k) The green and black post can be used to connect an external Deviation Meter when needed. It will accept any load from 200 ohms up. They are connected in parallel

with the Digital Meter and will output the same voltage as displayed on the DDM.

NOTE - These posts can be used as input to feed a calibration voltage to the Digital Meter. If you wish to use this function, it will be necessary to get access to the toggle switch (S100) on the Interface Board. Place that switch in CAL position. (This in fact opens the output circuit of operational amplifier U102.) Connect your calibration voltage to the posts. (Green post is negative.) When the test is concluded, return S100 to normal "up" position.

L) VOR DIGITAL RADIAL DISPLAY

Select the desired VOR frequency then place the switch (frequency, TO-From) in either TO or FROM position. The VOR radial will be displayed in place of the frequency by a three digit indicator with and accuracy of $\pm 1^{o}$

When using this function, the deviation and flag meter circuit is disabled. Only the AGC will be displayed when selected.

3 THEORY OF OPERATION

The Interface printed board contains the necessary switching logic and solid state switch circuit, along with the amplifier circuits providing suitable outputs to drive the Digital Panel Meter from either deviation, flag or AGC signal. It supplies also Amplified Deviation Signal to the Analog Deviation Meter M2 when S2 is in 15UA position.

3.1 POWER SUPPLY

Supply Voltage A from P4 goes from fuse F1 to PIN (18) of Loc. Rec. P2 and when the VIR 351 on/off switch is turned on, comes out on PIN (19) which supplies the voltage Regulator Circuit comprised of operational amplifier U104, Q1 and Associated components.

The regulated output +12V appears on the collector of Q1 and supplies the Loc. Rec. through P2 PIN (20) and the +8V and +5V Regulator ics.

The +5V Regulator U1 supplies the DPM through P3 PIN (K) and (9). The +8V Regulator U2 supplies the Interface Board through P1 PIN (7).

The necessary -5V supply comes from the DPM P3 PIN (8) and enter the Interface Board through P1 PIN (19).

3.1.2 SIGNAL SWITCHING

Selection Switch S1 is spring-loaded in center off position which applies a LOW input to inverter U100A PIN 1 which in turn gives a high or +8V to FET switch U-101 PIN (13) closing the corresponding switch section which applies the deviation (+left) signal to Resistor R-118 comprised in a precision resistor network. The common side of the deviation (+right) is applied to PIN (10) of the FET switch which is turned on by +8V from resistor R-113 applied to PIN (12) of U101.

When switch S1 is changed to FLAG position, it applies a ground to PIN 5 of inverter U100C causing a +8V to appear on PIN (6) of U101 FET switch. Also to PIN (1) of U100A which gives a ground on PIN (13) of U101 disabling the deviation signal FET switch. In this position, the flag voltage along with the common voltage are applied to U102 operational amplifier.

In the AGC position S1 applies a ground on PIN (3) of inverter U100B causing +8V to appear ton PIN (5) of U101. Also to PIN (1) of U100A which again disable the deviation FET switch. In this position, we turn the AGC FET switch on and turn the common voltage switch OFF by applying a ground to PIN (12) of FET switch U101.

3.1.3 AMPLIFIERS CIRCUIT

The operational amplifier U102 is used as a differential amplifier with unity gain which when properly balanced removes the common mode 5V on the deviation and flag circuits, providing an unbalanced signal line compatible with the DPM input.

In DEVIATION and FLAG function, the operational amplifier U-102 operates as a differential amplifier and only the difference between the signal and common line voltage will appear at PIN (6) of U102. In AGC function, the common voltage line is turned off while AGC voltage from POT R(111) is applied to R(118) U102 operates as a voltage follower and half the voltage from POT R(111) will appear on PIN (6) of U102.

Operational Amplifier U103 is a standard non-inverting amplifier with a gain of 5 determined by the feedback resistor network. Signal from U102 PIN (6) is applied to PIN (3) of U103 through FET switch transistor Q100. U103 multiplies this signal by 5 which increases the sensitivity of microammeter M2 when S2 is in 15UA position.

Transistor Q100 is on only when switch S1 is in deviation or center position. It is off in FLAG and AGC position, preventing overload of meter M2 when S2 is in 15 UA position.

NOTE: With S2 in 150UA position, analog meter M2 receives its signal from the VIR 351 deviation output through a 1.5K ohm resistor which gives a full scale reading of 150MV.

AUDIO AMPLIFIER

The proper speaker audio power is supplied by an audio amplifier IC U3 located on the chassis beside the regulator IC's. We derive the U3 audio input signal from the VIR 351 phone output. This signal comes from P2 pin(26) and enters the interface board through P1 pin (12) and after passing through a high pass filter comprised of C105,C106 and R107, it is adjusted by R108, comes out on P1 pin (13) and is applied to U3 pin (1). U3 output is on pin (4) which is connected to P1 pin (24) goes to C 102 which feeds the speaker through P1 (25) and the feedback divider circuit (R106,R105). Feedback is applied to U3 Pin (2) through C103 and P1 (11).

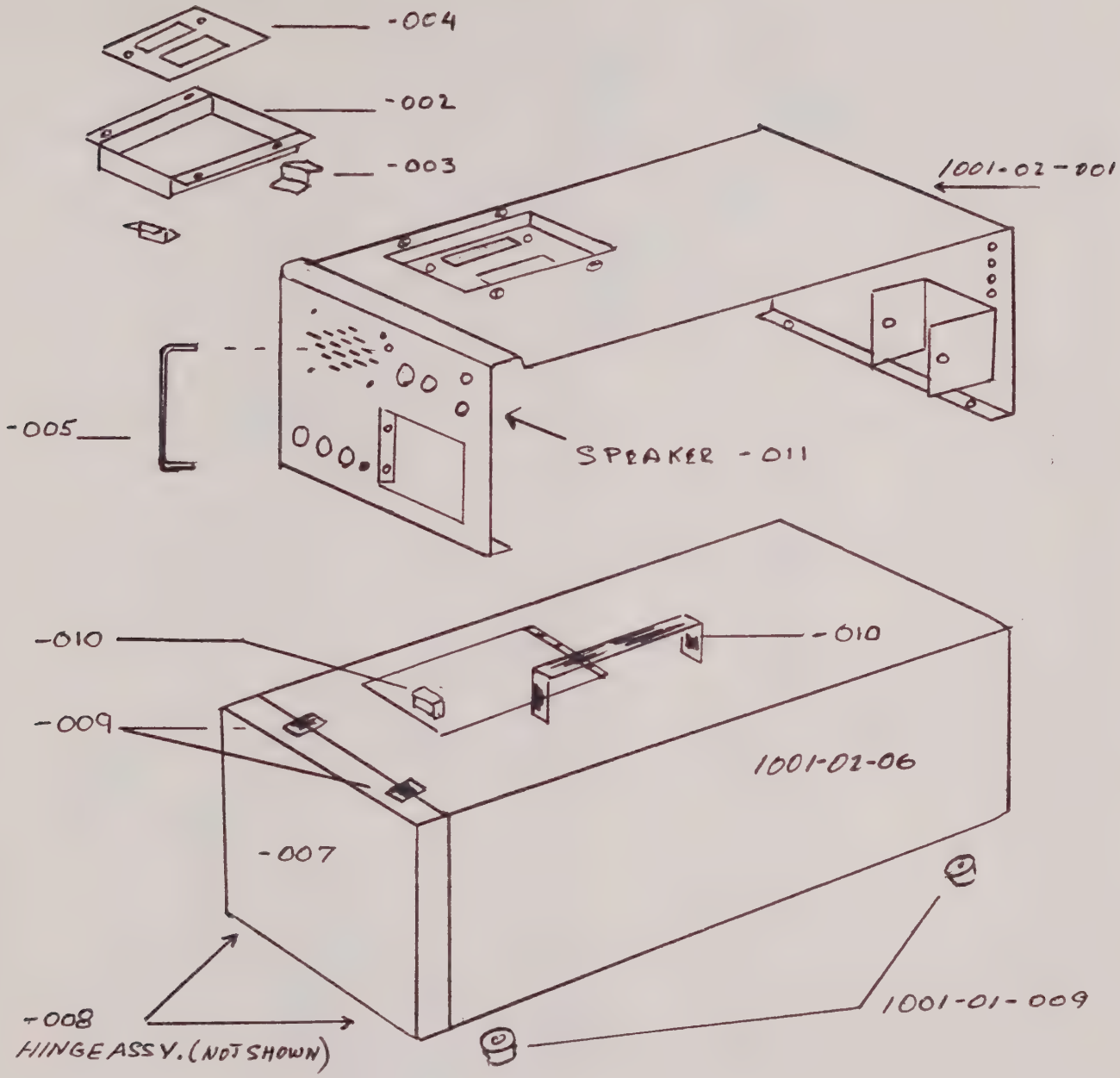
3.2 ADJUSTMENT

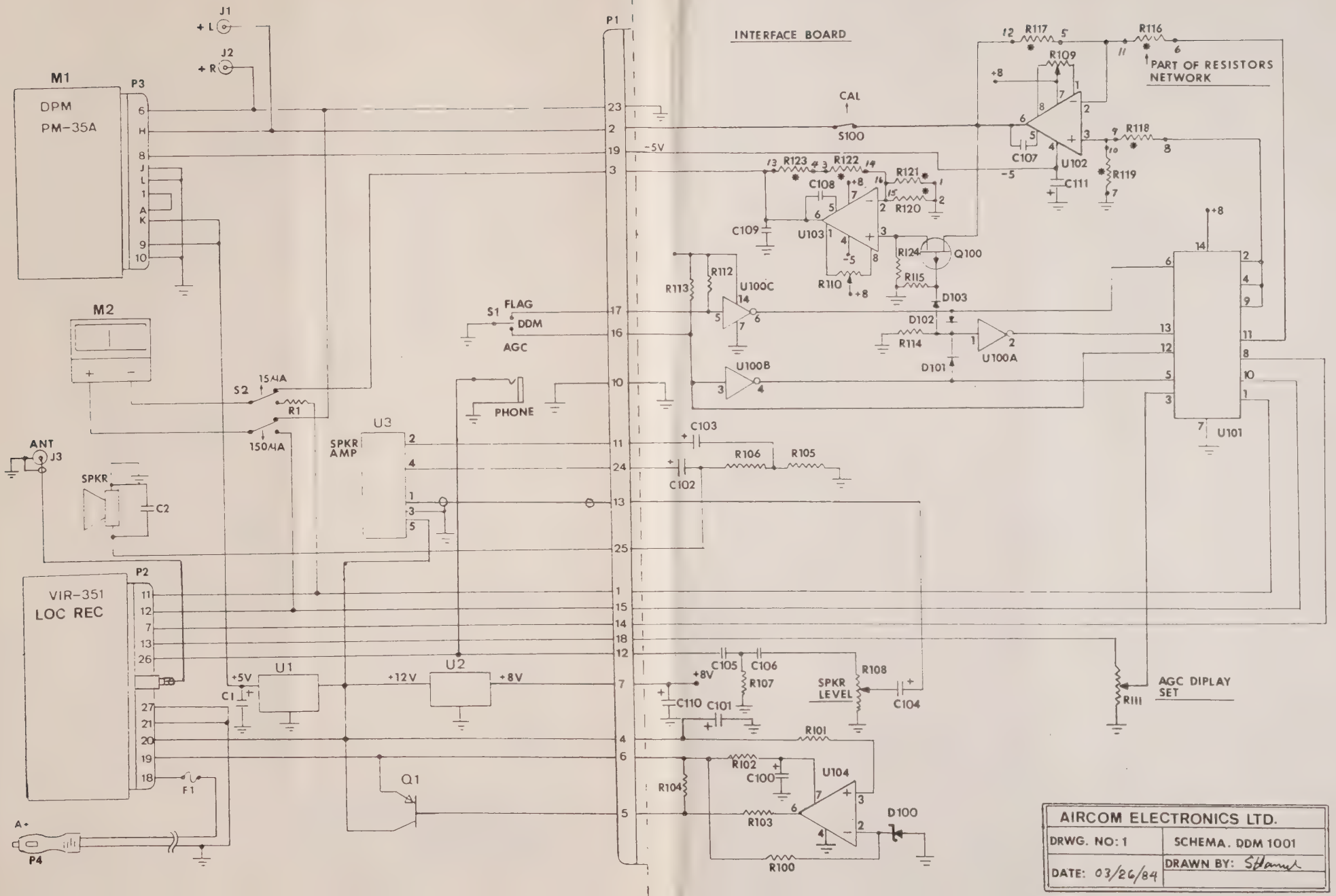
a) Place M2 sensitivity switch S2 in 150UA position.
b) Connect a Jumper between positive post (black lead) of M2 and PIN (1) of printed board connector P1.
c) Adjust POT R(109) on printed board for a ZERO display on the Digital Meter. (The access hole on bottom of chassis is identified by a D).
d) Disconnect jumper installed in Step (b).
e) Select the 110.10 MHz LOC chanel on the VIR 351 and adjust the Signal Generator for the same frequency. Modulate the generator with a standard 90/150 Hz LOC modulation (20% of 90 Hz and 20% of 150 Hz). Make sure both signals are at same level for a centered deviation reading. Adjust the generator RF level for 1,000 UV and connect the output to the DDM1001 Ant. Jack through a 6dB pad. Observe a zero display on the DDM. If not perfectly zero, adjust the VIR 351 Loc. centering until a proper zero reading occurs.
f) Place switch S2 in 15UA position and check for deviation on M2.
g) If M2 is not centered, adjust POT R(110) through access hole identified (A) for a perfect needle center.

h) Using a suitable Digital Voltmeter, measure the voltage on PIN 18 of P1, record this reading. (Normally between 4.5 to 5.0 volts.)
i) Place and hold switch S1 in AGC position and observe the display on the Digital Meter. It should read the same as recorded in Step (h) if different, adjust AGC POT R(111) for proper display.

NOTE: The Digital Meter will display a NEGATIVE polarity sign in AGC and FLAG function. This is normal for the actual circuit configuration.

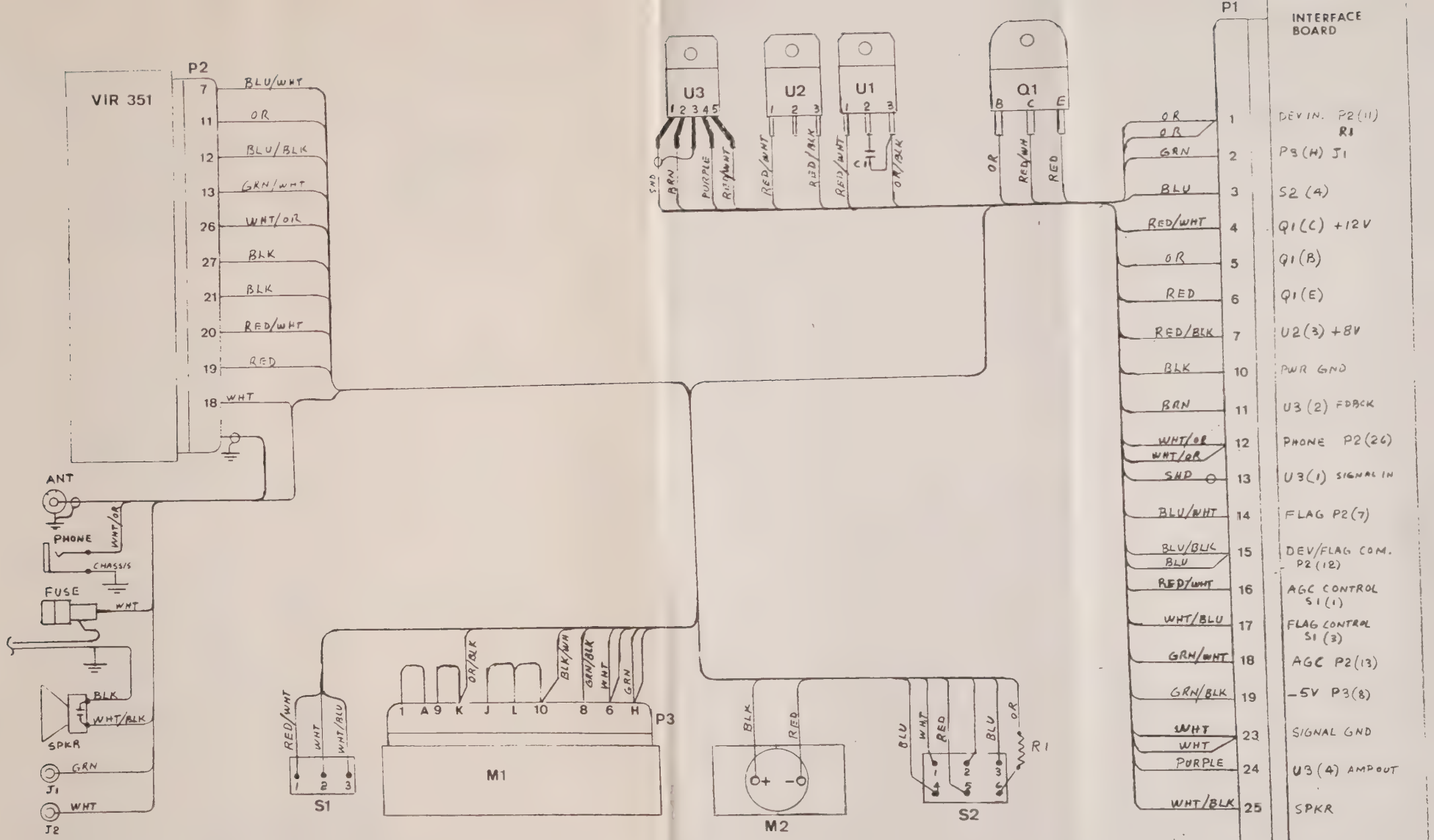
4.1 PARTS DIAGRAM (CHASSIS)





AIRCOM ELECTRONICS LTD.	
DRWG. NO: 1	SCHEMA. DDM 1001
DATE: 03/26/84	DRAWN BY: S Hamel

AIRCOM ELECTRONICS LTD.	
DRWG. NO: 2	DDM 1001 INTERFACE BOARD
DATE: 03/26/84	DRAWN BY: S Hamm



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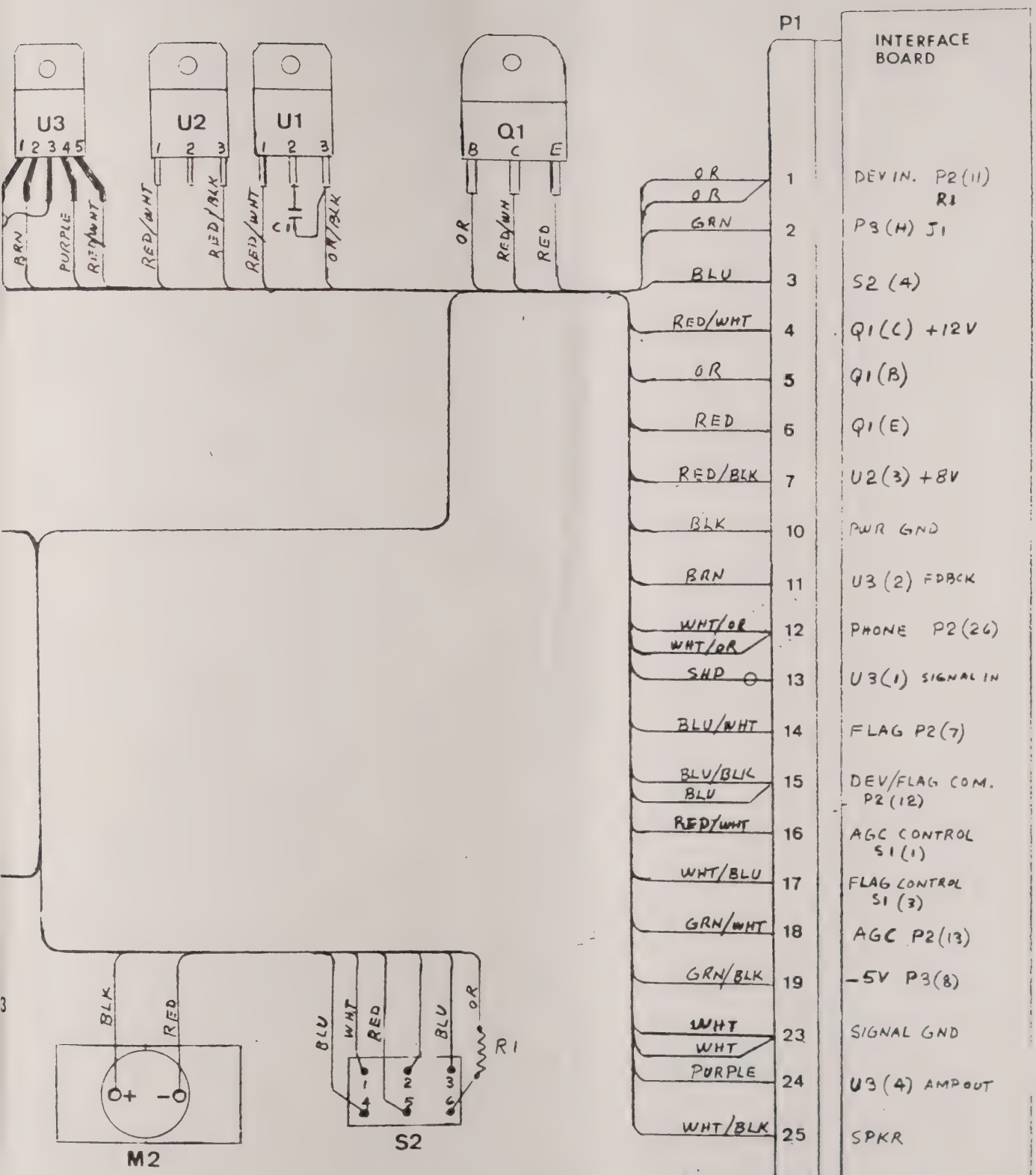

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4.4 PARTS LIST

	Hardware	Qty.	
1001-01-001	Meter Mt. Assy.	4	4x40x½ c/s
002	Speaker Attachment	4	4x40x½ p.k.
003	Analog Met. Att.	2	6x32 Hex Nuts
004	Frt. Handle	2	4x4x½ P.H.
005	PC BD MT	4	4x40x3/8 Pan.
006	Nylon Isolator Screw	4	PC BD MT
007	VIR 351 Install.	6	6x32x½ FH
008	VIR 351 Install. Nut	6	6x32 Hex Nuts
009	Rubber Feet Attach.	4	6x32½ Pan

Connectors

1001-09-001	Left Dev. Out
002	Right Dev. Out
003-4	Fuse Holder
005	Phone Jack
006	BNC Connector
007	Strain Relief, Power Cord
008	Power Cord Assy. 4'
009	Co-ax Assy. 4'
010	Fuse 2A
011	Connector, Meter
012	Connector, PC BD Cable
013	Connector, VHF 351
014	Pins for 1001-09-013

Chassis

1001-02-001	Inner Chassis
002	Meters Mounting Sub. Assy.
003	Meter, Analog Clamps (2)
004	Meter, Ident. Plate
005	Handle, Front, Chrome
006	Case, Carry incl. handle
007	Case, Cover Main.
008	Hinges, Cover (2)
009	Clasps, Cover (2) Pr.
010	Handle, Assy. Case Outer
010A	Catch Assy., Meter Lid (1)
011	Speaker
012	Main Harness Assy.- All but front panel components

Q-1	1001-04-000	Transistor Power (TIP 146)
U-1	1001-05-000	1C Regulator (MC7805CT)
U-2	1001-05-001	1C Regulator (MC7808CT)
U-3	1001-05-002	1C Audio AMP (CA-2002)
C-1	1001-07-000	Capacitor Tantal. 0.47MF/50V
C-2	1001-07-000	Capacitor Tantal. 0.47MF/50V

Switches

1001-09-001		SW1-DDM Function Sel - SPST (Spring)
	002	SW2 Scale Range - DPDT

P. C. Board

1001-08-001		PC BD Assy. Complete (PC 1001)
	002	PC BD Non-assembled (Bare)
	003	PC BD Test Switch
	004	PC BD Male Connector

U-100	1001-05-003	1C Mc14069
U-101	004	1C Mc14016
U-102	005	1C LM725CH
U-103	005	1C LM725CH
U-104	006	1C LM741CN
Q-100	1001-04-000	Transistor 2N 3820
D-100	001	Diode Zener IN 47
D-101	002	Diode IN 914
D-102	002	Diode IN 914
D-103	002	Diode IN 914
C-100	1001-07-000	Capacitor Tantalum 10 MF/35V
C-101	001	Capacitor Electrolytic 150 MF/25V
C-102	001	Capacitor Electrolytic 150 MF/25V
C-103	001	Capacitor Electrolytic 150 MF/25V
C-104	1001-07-000	Capacitor TanTac 10MF/35V
C-105	002	Capacitor .01 MF/
C-106	002	Capacitor .01 MF/
C-107	002	Capacitor .01 MF/
C-108	002	Capacitor .01 MF/
C-109	1001-07-002	Capacitor .01 MF/
C-110	1001-07-003	Capacitor TanTac 3.3 MF/50V
C-111	003	Capacitor TanTac 3.3 MF/50V
R-100	1001-06-000	Resistor 820 ohm/½ watt 5% carbon
R-101	001	Resistor 56 ohm ¼ watt 5% carbon
R-102	002	Resistor 100k ohm ¼ watt 5% carbon
R-103	003	Resistor 4.7k ohm ¼ watt 5% carbon
R-104	003	Resistor 4.7k ohm ¼ watt 5% carbon
R-105	004	Resistor 22 ohm ¼ watt 5% carbon
R-106	005	Resistor 220 ohm ¼ watt 5% carbon
R-107	003	Resistor Same as R103
R-108	004	Potentiometer 10K One turn
R-109	005	Potentiometer 100K 25 turns
R-110	005	Same as R-109
R-111	006	Potentiometer 50K 25 turns
R-112	007	Resistor 10K ohms ¼ watt 5% carbon
R-113	007	Same as R112
R-114	007	Same as R112
R-115	007	Same as R112
* R-116	008	*Part of Resistor Network
* R-117	008	Beckman P/N 698-3-R10K
* R-118	008	
* R-119	008	
* R-120	008	
* R-121	008	
* R-122	008	

* R-123 008
R-124 1001-06-007 Same as R-112

Meters

1001-03-01 Digital Pan. Met. M.1
02 Analog Met. M2

S E C T I O N 5

COLLINS VIR 351

ALIGNMENT PROCEDURES

(Included in DDM 1001 Manual for convenience)

Ref: COLLINS MANUAL
PN523-0766030-00411A
for overhaul and repair

5 TESTING AND ALIGNMENT PROCEDURES

This instruction book is designed to provide all information required for servicing the VIR-351 Navigation Receiver. Component layout drawings and schematics have been arranged in a manner that allows use of both while performing the test procedures. Test point waveforms are provided on the appropriate component layout drawings together with the oscilloscope settings needed to produce the waveforms shown. Refer to section VI for schematics and component location diagrams.

5.1 DEFINITION OF STANDARD TEST SIGNALS

5.1.1 INPUT LEVELS

Unless otherwise specified, all rf levels refer to the voltage at the input to a 6-dB, 50-ohm pad connected between the signal generator and the antenna jack. Refer to conversion table 5-8 if necessary.

5.1.2 STANDARD VOR TEST SIGNALS

5.1.2.1 VOR TEST SIGNAL

An rf carrier is amplitude modulated simultaneously with a 30-percent, 9960-Hz subcarrier and a 30-percent. 30-Hz variable phase signal. The 9960-Hz subcarrier is frequency modulated at a deviation ratio of 16 by a 30-Hz reference phase signal. The phase of the variable signal can be varied with respect to the reference phase signal.

5.1.2.2 VOR AUDIO TEST SIGNAL

A standard VOR audio test signal consists of the VOR test signal previously described, to which is added a 1020-Hz signal amplitude modulated 30 percent.

5.1.2.3 AUDIO TEST SIGNAL

An rf carrier is amplitude modulated 30 percent by a 1020-Hz signal.

5.1.3 STANDARD LOCALIZER TEST SIGNALS

5.1.3.1 LOCALIZER TEST SIGNAL

An rf carrier is amplitude modulated simultaneously with a 90-Hz ± 0.3-percent signal and a 150-Hz ± 0.3-percent signal so that the separate modulation percentages are equal and their sum equals 40 ± 2 percent. When each signal is applied separately, the carrier is modulated 20 ± 1 percent.

5.1.3.2 LOCALIZER CENTERING SIGNAL

A standard localizer centering signal consists of the localizer test signal where the difference in depth of modulation (DDM) of the 90- and 150-Hz signals is less than 0.002 (0.1 dB).

5.1.3.3 LOCALIZER DEVIATION SIGNAL

A standard localizer deviation signal consists of the localizer test signal where the DDM of the 90- and 150-Hz signals is 0.093 ± 0.002 (4.0 ± 0.1 dB).

5.1.3.4 LOCALIZER AUDIO SIGNAL

A standard localizer audio signal consists of the localizer test signal, to which is added a 1020-Hz audio signal amplitude modulating the rf carrier 30 percent.

5.2 CUSTOMER ACCEPTANCE/MINIMUM PERFORMANCE TEST PROCEDURES

The customer acceptance/minimum performance test procedures should be performed after minor repairs have been completed, or as a preinstallation test procedure prior to unit installation in the aircraft. Neither unit disassembly nor cover removal is required to perform these tests; no adjustment procedures are included. The intent of these test procedures is to establish that the unit is operating properly and is ready for installation.

Selected portions of the test procedures are broken into two distinct methods of testing. The primary difference between the two methods is the test equipment used to perform the procedure. The first procedure, which is the preferred method, utilizes a precision track selector/precision resolver and a dc voltmeter (deviation meter) for observing indicator drive levels. The second method substitutes an IND-350A/351A/351D or IND-350/351/351C Indicator for the precision equipment. Each test method is clearly identified by the title of the test. Procedures for testing the IND-350A/351A/351D Indicator are included in paragraph 5.5.3.2 of this instruction book; procedures for testing the IND-350/351/351C Indicator are presented in paragraph 5.5.3.3. Refer to table 5-5 for a list of test equipment required to perform the customer acceptance/minimum performance test procedures.

Connect the VIR-351 to the test equipment as shown in figure 5-7 or 5-8 and apply power to all equipment, allowing sufficient time for warmup and stabilization. If the signal generator includes a to/from switch for VOR bearings, it should be in the from position for all tests.

NOTE - All specified rf signal generator output levels are read directly from the attenuator dial of a generator with a 6-dB pad connected in series with its output. If a 6-dB pad is not used, divide all rf levels by 2 or decrease the generator output 6dB. Example: 10 μ V (-87 dB mW); without pad, set generator to 5 μ V (-93 dB mW).

CAUTION - All instrumentation outputs (resolver and meter leads) are at approximately +5 V dc. Track selector/course resolver and all meter leads must be floating; a ground on any output will produce erroneous indications. Common-mode voltages for the various instrumentation outputs may vary slightly, so no two leads may be connected together.

5.2.1 CHANNELING

a. Set the TO/FREQ/FROM control to FREQ.
b. Rotate MHz and kHz selector knobs while observing electronic display. Result: Proper sequencing of electronic display is noted.

5.2.5 RECEIVER GAIN

a. Channel VIR-351 to 113.00 MHz. Set signal generator to 113.00 MHz and apply a standard VOR audio test signal with rf amplitude of 10 μ V.
b. Pull VOR/ID control out into the IDENT position, and rotate knob fully clockwise. Result: Audio output should be greater than 50 mW into 600 ohms.

5.2.6 IDENTIFICATION FILTER

a. Channel VIR-351 to 113.00 MHz. Set signal generator to 113.00 MHz and apply a standard VOR audio test signal with rf amplitude of 1000 μ V.
b. Pull VOL/ID control out into the IDENT position, and adjust volume to produce 50 mW into 600 ohms.
c. Push volume control knob in without rotating it and observe audio output indication. Result: Audio output should not exceed 2.5 mW.

5.2.7 RECEIVER AGC

a. Channel VIR-351 to 113.00 MHz. Set signal generator to 113.00 MHz and apply a standard VOR audio test signal at 20 000 μ V.
b. Pull the VOL/ID control out into the IDENT position and adjust control for a 50-mW indication on the audio power meter.
c. Reduce generator rf signal level to 10 μ V and observe audio power meter. Result: Audio output must be at least 25 mW.

5.2.8 VOR BEARING ACCURACY

5.2.8.1 PROCEDURE USING TRACK SELECTOR AND DEVIATION METER

a. Channel VIR-351 to 113.00 MHz. Set signal generator to 113.00 MHz and apply a standard VOR test signal at 1000 μV. Connect deviation meter to P1-11 and P1-12.
b. Set track selector to exactly 060 degrees. Adjust signal generator bearing setting until 0 mV is indicated on deviation meter (0 mV will be obtained in the vicinity of 060 and 240 degrees). Record generator bearing at this point.
c. Set track selector to exactly 150 degrees and adjust signal generator bearing setting until 0 mV is indicated on deviation meter (0 mV will be obtained in the vicinity of 150 and 330 degrees). Record generator bearing at this point.
d. Results recorded in steps b and c should differ by no more than 1 degree from track selector setting or its reciprocal (059 to 061 degrees, 239 to 241 degrees, 149 to 151 degrees, 329 to 331 degrees).

5.2.11 DIGITAL BEARING ACCURACY

a. Channel VIR-351 to 113.00 MHz. Set signal generator to 113.00 MHz and apply a standard VOR test signal at 1000 μV.
b. Set VIR-351 TO/FREQ/FROM switch to FROM.
c. Successively set signal generator bearing to 000,060, 120, 180, 240 and 300 degrees while observing VIR-351 electronic display. Result: Bearing displayed on VIR-351 is within $\pm$2 degrees of generator bearing and letter F follows each indication.
d. Switch VIR-351 TO/FREQ/FROM switch to TO.
e. Successively set signal generator bearing to 000, 060, 120, 180, 240, and 300 degrees while observing VIR-351 electronic display. Result: Bearing displayed on VIR-351 is 180 $\pm$2 degrees different from signal generator bearing settings.

5.2.13 LOCALIZER CENTERING ACCURACY

5.2.13.1 PROCEDURE USING DEVIATION METER

a. Channel the VIR-351 to 110.50. Set signal generator to 110.50 MHz and apply a standard localizer centering signal. Connect deviation meter to P1-11 and P1-12.
b. Set the signal generator output level to 10 μV and note deviation meter indication. Result: Not more than 8 mV.
c. Increase generator output level to 1000 μV and then to 10 000 μV and note deviation meter indication for each level. Result: Not more than 8 mV for each input level.

5.2.14.1 PROCEDURE USING DEVIATION METER

a. Channel the VIR-351 to 110.50 MHz. Set signal generator to 110.50 MHz and apply a standard localizer deviation signal (90>150) at 1000 μV.

b. Connect deviation meter positive lead to P1-12 and negative lead to P1-11. Note deviation meter indication. Result: +90 ± 20 mV.
c. Apply a standard localizer deviation signal (150 > 90) at 1000 μV and observe deviation meter indication. Result: -90 ± 20 mV.

5.2.15 LOCALIZER FLAG PERFORMANCE

5.2.15.1 PROCEDURE USING DEVIATION METER

a. Channel the VIR-351 to 110.50 MHz. Set the signal generator to 110.50 MHz and apply a standard localizer centering signal at 10 μV.
b. Connect deviation meter positive lead to P1-7 and negative lead to P1-8. Observe meter indication. Result: At least 250 mV.
c. Reduce signal generator output level to zero and observe deviation meter indication. Result: Not more than 180 mV.
d. Set signal generator rf output level to 1000 μV and audio output to 90-Hz modulation only (20 percent) and observe deviation meter indication. Result: Not more than 180 mV.
e. Set signal generator for 150-Hz modulation only (20 percent) and observe deviation meter indication. Result: Not more than 180 mV.

5.3 DETAILED PERFORMANCE TESTING AND ALIGNMENT PROCEDURES

NOTE - All specified rf signal generator output levels are read directly from the attenuator dial of a generator with a 6-dB pad connect in series with its output. (Some generators have a built-in 6-dB pad; others do not and require that one be added as shown in figure 5-9.) If a 6-dB pad is not used, divide all rf levels by 2 or decrease the generator output 6 dB. Example: 10 μV (-87 dB mW); without pad, set generator to 5 μV (-93 dB mW).

Connect the test equipment listed in table 5-6 to the VIR-351 as shown in figure 5-9.

5.3.1 VIR-351 NAVIGATION RECEIVER

5.3.1.1 POWER SUPPLY

a. Turn VIR-351 on and set TO/FREQ/FROM switch to FREQ position. Monitor +5-V dc output voltage at A2E9 while slowly increasing primary input voltage. Do not apply full 13.75 V dc until it is established that the +5-V dc source is regulating.
b. Adjust A2R4 for +5 V dc at A2E9. Adjust A5R48 for +10 V dc at A2E5.
c. Note primary current drain is less than 1.0 A. Turn VIR-351 off and on using front panel VOL/ID switch, and verify proper operation.

d. Vary the primary input power in approximately 0.5-volt steps from 11.0 V dc to 15.1 V dc to ensure internal power supplies are regulating. Refer to the following table for test points and tolerances.

SUPPLY	TEST POINT	REGULATION
-5 V dc	A2E9	+5.1 ±0.1 V dc
-10 V dc	A2E5	+10.0 ±0.05 V dc
-12 V dc	A2E7	-12.0 ±0.75 V dc

5.3.1.2 DISPLAY LIGHT DIMMING

a. Cover photocell with a soft, opaque, lintless material.
b. Adjust DISPLAY BRIGHTNESS (A1R1) for 2.3 V dc at A2E10. DISPLAY BRIGHTNESS control A1R1 may be adjusted through access hole in front panel.
c. If the VIR-351 has a WPT annunciator, remove photocell cover and ground P1-16. Verify that WPT annunciator comes on.
d. Cover photocell with soft, opaque, lintless material and verify the WPT annunciator dimming operates.

5.3.1.3 SYNTHESIZER

a. Apply primary power and channel VIR-351 to 108.00 MHz.
b. Measure +5.0 ±0.1 V dc at A3TP7. If necessary, adjust A3L102 until result is obtained.
c. Channel VIR-351 to 117.95 MHz.
d. Measure +9.0 ± 0.1 V dc at A3TP7. If necessary, adjust A3C104 until result is obtained.

NOTE - The following step should be performed only if a wave analyzer is available.

e. Channel VIR-351 to 113.00 MHz and connect wave analyzer to TP5 with a short length of coax, less than 60 cm (24 in). Set analyzer to 50 kHz and adjust A3L2 for minimum indication. Remove coax.

5.3.1.4 RECEIVER ALIGNMENT

a. Connect dvm to AGC test point (A6TP2). Set rf generator to 110.20 MHz and modulate 30 percent with 30 Hz. Channel VIR-351 to 110.20 MHz.
b. Connect the rf generator through a 6-dB pad to the antenna connector and set the generator to -67 dB mW.
c. Adjust A6L1, A6L2, A6L4, A6L5, A6L10, and A6C23 for maximum AGC voltage. If -67 dB mW does not produce a usuable AGC indication, increase signal level until adjustment can be made. Final adjustment must be made, however, at -67 dB mW.
d. Set rf signal generator output level at 1000 μV (-47 dB mW) and connect meter to gate 2 of Q1 (junction

of Q1 tate 2, C9, R3, and Q3 collector). Indication at this point must be 1.4 ±0.05 V dc. If necessary, adjust RF AGC DELAY potentiometer R39 until correct results are obtained.

e. Connect meter to A6TP3 and measure 0.5 ±0.025 V rms. If necessary, adjust DETECTOR LEVEL (R29) until a result is obtained.

f. Turn VOL/ID control to the maximum clockwise position and pull VOL/ID switch to identification position.

g. Connect an audio power meter using 600-ohm impedance and 500 mW full scale across pins 26 (NAV AUDIO) and pin 27 (GND) of rear connector P1.

h. Vary rf input level from 3 μV to 20 000 μV (-97.5 to -21 dB mW) and observe audio output level. Level is 50 mW (5.4 V rms) or greater over entire range.

i. Rotate VOL/ID control fully counterclockwise and note that output level is reduced 25 dB minimum.

j. Apply a standard audio test signal at 110.20 MHz, 1000 μV. Modulate 30 percent with 1020 Hz.

k. Push VOL/ID switch to voice position. If board revision letter is V or above, adjust R119 for minimum audio output. If board revision letter is A through U, adjust R106 and R103 for minimum audio output. In either case, attenuation of the 1020-Hz tone must be greater than 15 dB.

5.3.1.6 RECEIVER GAIN AND SENSITIVITY

a. Apply a standard VOR audio test signal at 108.00 MHz, 3 μV (-97.5 dB mW). Channel VIR-351 to 108.00 MHz. Connect audio voltmeter and audio power meter to VIR-351 audio output terminals (pins 26 and 27 of P1) and adjust the volume control to produce a 5.48 V rms output.

b. Remove 30-percent modulation signal and calculate (s+n)/n in dB for each of the following frequencies: 108.00 MHz, 112.00 MHz, 117.95 MHz. For each frequency the signal-to-noise ratio should be no less than 10 dB.

NOTE - Step "c" pertains to NAV receiver circuit board assemblies with revision letter "U" or above only.

c. Set rf signal generator to 1000 μV (-47 dB mW) and reapply modulating signal. Pull IDENT switch out and adjust volume control to provide a 50-mW output (5.48 V rms across 600-ohm load). Push IDENT switch into VOICE position and observe audio output. Result: 1020-Hz tone attenuated at least 15 dB (0.97 V rms maximum across 600-ohm load).

5.3.1.8 LOCALIZER

a. Apply a localizer centering signal at 110.30 MHz, 1000 μV (-47 dB mW). Channel VIR-351 to 110.30 MHz.

b. Connect a 165-ohm load resistor and a deviation voltmeter to +LEFT (P1 pin 11) and +RIGHT (P1 pin 12).

NOTE - Voltmeter must be floating since common lead will be referred to +5.6 V dc (+ LEFT, pin 11).

c. Adjust LOC ZERO (A5R26) to null localizer deviation to within ±0.5 mV.
d. Set localizer audio generator to 4 dB (150>90) and observe meter. Result: +90 mV ±5 mV.
e. Apply a localizer deviation signal at 110.30 MHz. 1000 μV (90>150), 4 dB, and observe deviation meter. Result: -90 mV ±5 mV.
f. Apply a localizer centering signal at 110.30 MHz, 10 μV (-87 dB mW). Observe deviation meter. Localizer deviation centering within ±1 mV.
g. Increase rf input level to 10 000 μV (-21 dB mW), and observe deviation meter indication. Localizer deviation centering within ±1 mV.
h. Connect flag meter positive lead to +NAV FLAG (P1 pin 7) and common lead to -NAV FLAG (P1 pin 8). Reduce rf input level to 3 μV (-97.5 dB mW), and observe NAV flag voltage. Result: Greater than 250 mV.
i. Increase rf input level to 1000 μV (-21 dB mW). Set localizer audio generator for 90 Hz only and observe flag meter. Result: Less than 180 mV (flag in view).
j. Set localizer audio generator for 150 Hz only and observe flag meter. Result: Less than 180 mV (flag in view).

5.3.1.9 DIGITAL BEARING CONVERTER

a. Apply a standard VOR test signal at 110.20 MHz, 1000 μV. Channel VIR-351 to 110.20 MHz.
b. Switch the TO/FREQ/FROM switch between FROM and TO, set track selector to 0 degrees and verify ±1-degree accuracy for each of the following radials.

RADIAL	*FROM	*TO
0	0	180
30	30	210
60	60	240
90	90	270
120	120	300
150	150	330
180	180	0
210	210	30
240	240	60
270	270	90
300	300	120
330	330	150

*Both FROM and TO indications must be within ±1 degree of desired result.

If the preceding results are not obtained, perform alignment procedure of steps "c" through "e".

c. Apply a standard VOR test signal at 114.90 MHz, 1000 μV. Set radial control to 59.6 degrees. Set TO/FREQ/FROM switch to FROM position and adjust RADIAL ZERO (A5R7) for a reading of 59 degrees F.
d. Slowly increase RADIAL ZERO (A5R7) until a reading of 60 degrees F is obtained.
e. Set the radial control to 60.4 degrees, and note a 60-degree F indication is held when the radial control is varied between 59.6 degrees and 60.4 degrees. Repeat steps "c" and "d" if necessary.
f. Set radial control and track selector to 60 degrees and record deviation sensitivity using a 1000-μV rf input signal.
g. Measure deviation change which occurs when radial control is changed from 60 degrees to 50 degrees, and when changed from 60 degrees to 70 degrees. Result: Maximum change, 150 $\pm$ 7.5 mV.
h. Reduce rf-input level slowly while observing electronic display. When the radial converter threshold level is met, the display will show three dashes (---) in the TO position or three dashes and an F (---F) in the FROM position. The threshold level should be less than 3 μV of rf input.

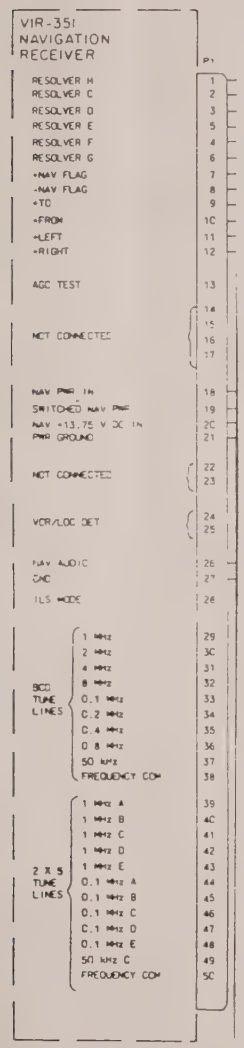
5.4 TEST EQUIPMENT

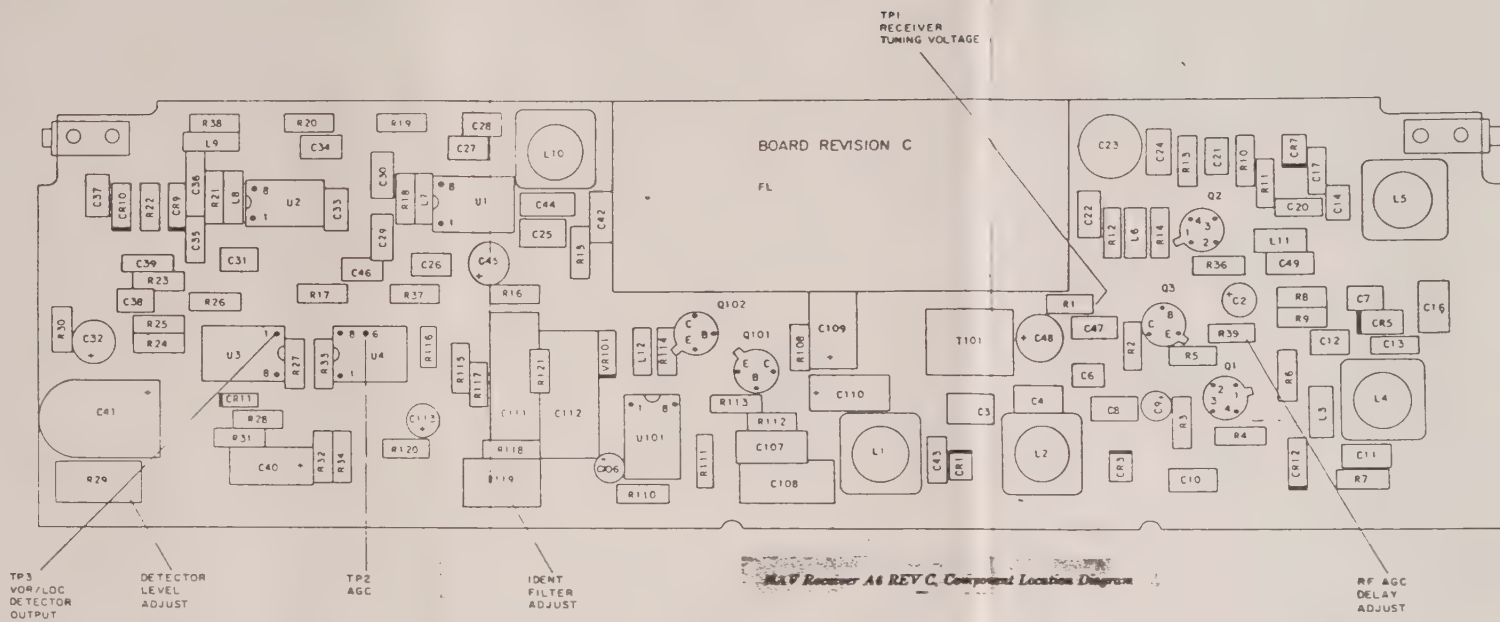
Detailed Testing and Alignment Procedures Test Equipment.

EQUIPMENT	CHARACTERISTIC REQUIRED
VOR/LOC generator	Frequency range: 108.00 through 117.95 MHz
	Output impedance: 50 ohms
	Rf output range: 1 to 20 000 μV
	Rf attenuator accuracy: ±2 dB
	VOR bearing accuracy: ±0.25 degree
	Localizer centering accuracy: 0 ±0.003 DDM
	Localizer deviation accuracy: within 0.0075 DDM at 0.093 DDM
	Ident tone: 1020 ±10 Hz
Precision track selector	Bearing output: calibrated resolver or tapped transformer equivalent to synchro resolver. Calibrated for 30-Hz ORZ referenced bearing indications per RTCA paper DO-62.
*Flag indicator	500 μA meter having 1000 ohms internal resistance
*Deviation indicator	Zero center; ±150 μA meter having 1000 ohms internal resistance
Audio power meter	Power range: to 150 mW
	Accuracy: ±1.5 dB
	Impedance: 600 ohms resistive
Ac vtvm	Capable of measuring a null of less than 5 mV at 30 Hz, 5% accuracy at full scale.
Attenuator pads	6 dB, 50 ohms
Digital voltmeter	Voltage range: 0 to 20 volts
	Resolution: 1 mV
	Accuracy: ±1 mV for voltages up to 250 mV
	Input impedance: at least 100 000 ohms
Oscilloscope	Any dc coupled scope (used for waveform observation only)

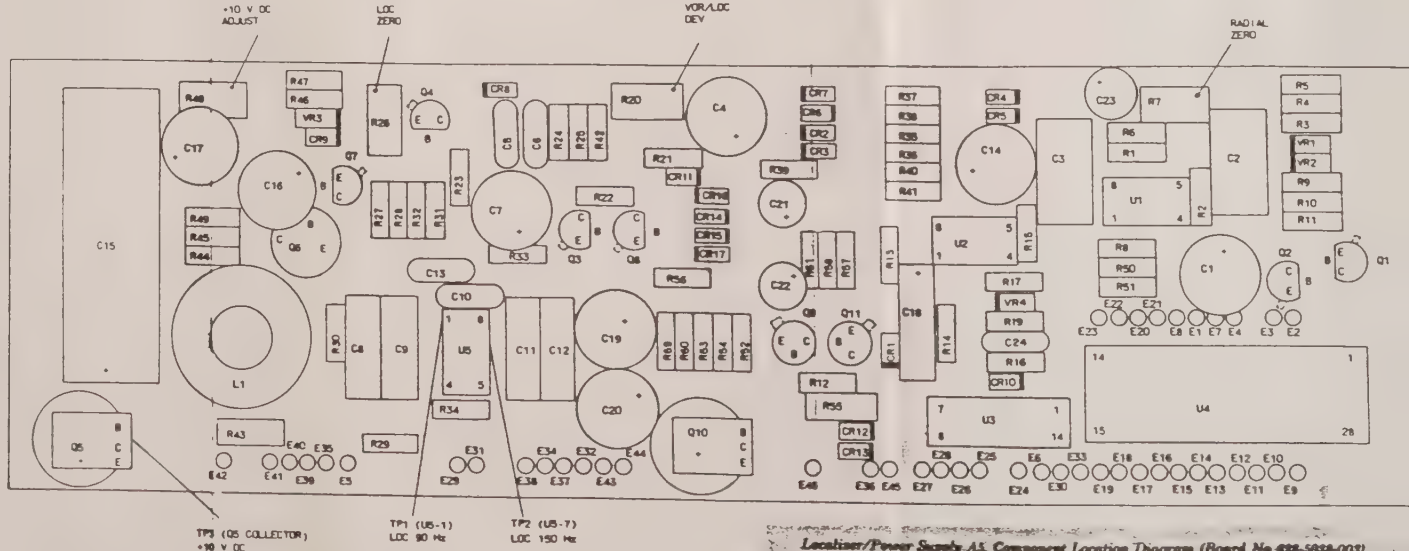
*Dc millivoltmeter may be used in lieu of microammeter.

5.5 VIR 351 DIAGRAMS





NAV Receiver A6 REV C, Component Location Diagram



Localizer/Power Supply A5, Component Location Diagram (Board No 622-5838-003)

TEXMATE INC

PM-35A 3½ DIGIT PANEL METER

A PRECISION LOW COST GENERAL PURPOSE DIFFERENTIAL INPUT METER POWERED FROM 5VDC

DESCRIPTION

The PM-35A is a popular, general purpose 5VDC powered instrument. More than 20,000 units have been installed throughout the world in thousands of different applications, attesting to the meter's utility and reliability. A single CMOS/LSI dual slope autozeroing analog to digital converter is used and the unit measures true differential or single-ended DC voltages over five user programmable ranges from ±199.9mV to ±1200V full scale. Maximum resolution is 100μV over ±1999 counts. Provision has been made for many user selectable operating modes, including a current meter, ratiometric ohmmeter, and a temperature meter.

An additional feature of the PM-35A is an on board DC to DC converter that produces a regulated −5VDC with sufficient output to provide up to 10mA of auxiliary power for external user circuitry.

The differential input capability of the PM-35A has a wide common mode voltage range of ±2.8V and a high common mode DC voltage rejection ratio of 60dB. Common mode signals are those which are present equally on both input terminals but do not develop a differential voltage between them. This capability is particularly useful for making accurate measurements of very small signals in the presence of much larger common mode signals. The PM-35A is ideal for measuring various balanced transducers and bridge inputs and long term drift of the excitation voltage can be compensated for by using the external reference differential ratiometric mode of operation.

The model PM-35A provides a normal mode rejection of 30dB. Thus, signals which create a potential difference between the input terminals and which act as noise on the signal input are rejected within this limit. Normal mode signals are most often caused by electrostatic or electromagnetic induction on the input.

The 6.9V primary reference of the PM-35A enables a wide range of scaling in engineering units without the necessity to attenuate the input signal with the consequential loss of high input impedance.

SPECIFICATIONS

Input Configuration:	True differential and single-ended
Full Scale Ranges:	±199.9mVDC ±1.999VDC (standard) ±19.99VDC ±199.9VDC ±1200VDC
Input Impedance:	Exceeds 1000MΩ on 200mV and 2V ranges; 10MΩ on all other ranges
Input Protection:	±500VDC or 350VAC on 200mV and 2V ranges; ±1200VDC or 850VAC on all other ranges
Normal Mode Rejection:	30dB at 50Hz and up
Common Mode Rejection:	60dB at DC
Common Mode Voltage:	±2.8V
Accuracy:	±(0.05% of reading + 1 digit)
Maximum Resolution:	100μV over ±1999 counts
Temperature Coefficient:	5PPM/°C in ratiometric operation; 50PPM °C using internal reference on 200mV and 2V ranges
Zero Stability:	Autozeroed; 1μV/°C Typ
Conversion Rate:	3 readings per second nominal; user programmable from 1 to 20 readings per second
Display:	0.56" LED
Polarity:	Automatically displays either "+" or "−"; may be blanked by user programming
Decimal:	User programmable to any one of 4 positions
Overload Indication:	When input exceeds full scale on any range being used, most significant "1" digit and polarity symbol are displayed with all other digits blank
Power Requirements:	+4.5 to +5.5VDC at 200mA
Warmup Time:	10 seconds to specified accuracy
Operating Temperature:	0°C to +60°C

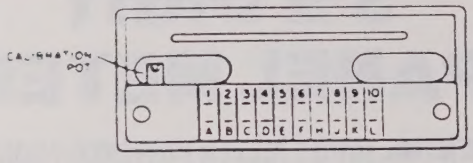
ORDERING INFORMATION

	Order Part No.
STANDARD 3½ DIGIT PANEL METER (2V Range)	PM-35A
ACCESSORIES: Edge Connector (20 pin solder tabs)	CN-L10
OPTIONS: Factory Installed 200mV Range	VA-200MVFI
Factory Installed 20V Range	VF-0020V
Factory Installed 200V Range	VF-0200V
Factory Installed 1200V Range	VF-1200V
Factory Installed Special Scaling (Specify input signal, the span, and digital reading required e.g. 0 to 5V input to display 0 to 1999; e.g. 0 to 2V input to display 0 to 1800)	VS-3.5

	Order Part No.
RANGE CHANGE KITS: (matched resistors for user installation)	
200mV Range	VA-200MV
20V Range	VK-0020V
200V Range	VK-0200V
1200V Range	VK-1200V
EVALUATORS KIT: (selected components to evaluate most circuit applications — includes 50KΩ offset pot)	PM-35AKIT
OPTIONAL CASES: End Mount Case (see back page for details)	EM-CASE
Center Mount Case (see back page for details)	CM-CASE
Full Bezel Case (see back page for details)	FB-CASE
Slim Line Case (supplied as standard)	SL-CASE

CONNECTOR PINOUTS

The Texmate Model PM-35A interconnects by means of a standard PC board edge connector having two rows of 10 pins, spaced on 0.156" centers. Connectors are available from Texmate, or from almost any connector manufacturer.



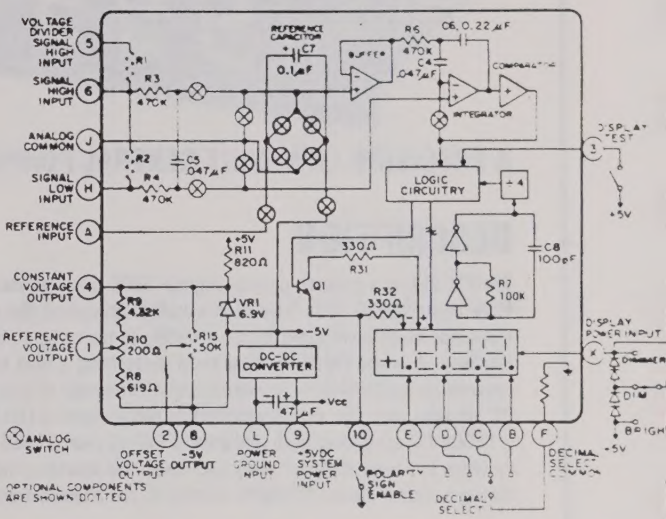
REAR VIEW OF METER CASE

A—	Reference Input	1—	Reference Voltage Output
B—	Decimal Select (1XXX.)	2—	Offset Voltage Output
C—	Decimal Select (1XX.X)	3—	Display Test
D—	Decimal Select (1X.XX)	4—	Constant Voltage Output
E—	Decimal Select (1.XXX)	5—	Voltage Divider Signal High Input
F—	Decimal Select Common	6—	Signal High Input
H—	Signal Low Input	7—	No Connection
J—	Analog Common	8—	−5V Output
K—	Display Power Input	9—	+5VDC System Power Input
L—	Power Ground Input	10—	Polarity Sign Enable

CAUTION: This meter employs high impedance CMOS inputs. Although internal protection has been provided for several hundred volt overloads, the meter will be destroyed if subjected to the high kilovolts of static discharge that can be produced in low humidity environments. Always handle the meter with ground protection.

FUNCTIONAL DIAGRAM

The diagram below depicts the Model PM-35A in its standard 2V F.S. form with all component values indicated for this mode of operation. Variations from the standard for use in special applications will be found under the heading Typical Application Circuits & Connection Instructions.



PIN DESCRIPTIONS

Pin A — Reference Input: Reference voltage input for A to D converter. Normally supplied from Pin 1. An external reference source referred to Pin 8 may be used instead. Pin 1 may be used as an input for ratiometric measurements. Minimum usable voltage is .05VDC, with a maximum voltage of 5.0V. For ratiometric operation, displayed reading = 1000 × (Signal input Voltage ÷ Reference input Voltage). The maximum signal input voltage is 5V. Higher voltages must be scaled down through voltage divider. Reference input voltage must remain stable during measurement period. **CAUTION:** Since Pin 8 is floating at −5V the low side of the external reference source must be isolated from the 5V power ground of the meter (Power Ground Input Pin L).

Pins B, C, D, and E — Decimal Select: Decimal points may be displayed as required by connecting the appropriate pin to Decimal Select Common Pin F. The internal current limiting resistor on Pin F is designed to enable only one decimal point. If more than one decimal point is enabled simultaneously their light output will be reduced. **CAUTION:** Do not connect any Decimal Select Pin directly to Power Ground Input Pin L as the excessive current will destroy the LED in the decimal point display.

Pin F — Decimal Select Common: Decimal points are dislayed as required by connecting Pin F to the appropriate Decimal Select Pins B, C, D, or E.

Pin H — Signal Low Input: Signal low input of A to D converter. Maximum overvoltage protection is ±500VDC or 350VAC.

Pin J — Analog Common: This is the floating common for the analog section which is normally +2.2V above Power Ground Input Pin L. Pin J may be left floating or it may be connected to Power Ground Input Pin L without overloading. When Pin J is tied to Pin L, the common-mode voltage (CMV) of the A/D converter is reduced, which can improve the performance of the meter in some configurations such as the case with Single-Ended inputs.

Pin K — Display Power Input: Power input for LED display drive. For normal operation, connect directly to +5VDC System Power Input Pin 9. Display may be blanked or dimmed by reducing or removing voltage between Pin 9 and Pin K. The power supply to the A to D converter and logic circuits is independent to that of the display. When operated in a power conserving "press-to-read" mode, the reading is instantaneously displayed without any settling time.

Pin L — Power Ground Input: Negative terminal of +5VDC power should be connected to Pin L. All digital signals should be returned to this ground point. Pin L is not internally connected to Analog Common Pin J.

Pin 1 — Reference Voltage Output: Internal precision voltage reference. Standard output is 1.000V, adjustable by ±5% with R10 potentiometer. Usable voltages from 0.05V to 5.0V for special high impedance scaling can be obtained by changing the value of internal dividing resistors R8 and R9. It should be noted that Pin 1 is+1.0V referred to −5V Output Pin 8, or Pin 1 is −4.0V referred to Power Ground Input Pin L.

Pin 2 — Offset Voltage Output: −5V to +1.9V is available with the addition of ¾" 50K ohms potentiometer in the R15 position on the PC board. It is referred to −5V Output Pin 8. An example is shown in the thermometer application drawing.

Pin 3 — Display Test: All display segments will operate when Pin 3 is connected to +5VDC System Power Input Pin 9.

Pin 4 — Constant Voltage Output: Pin 4 is 6.9V referred to −5V Output Pin 8. The offset voltage and reference voltage are both generated internally from the constant voltage available at Pin 4.

Pin 5 — Voltage Divider Signal High Input: Signal high input for voltages that require attenuation or scaling. Dividing resistors R1 and R2 may be mounted internally for voltages up to 1200V max. Matched dividing resistors for 20V (1/10), 200V (1/100), nd 1200V (1/1000) ranges are available from Texmate. Shunt resistors for current measurements up to 200mA may be internally mounted in the R2 position. The current loop input is then applied to Signal High Input Pin 6 and returned through Signal Low Input Pin H.

Pin 6 — Signal High Input: Signal high input of A to D converter. Maximum overvoltage protection is ±500VDC or 350VAC.

Pin 7 — No Connection: This connection pin goes to an unused PCB pad which may be used to mount optional components.

Pin 8 — −5V Output: Auxiliary −5V power output (10mA max.) produced by an internal DC to DC converter. Pin 8 can be also used as a point of reference for calibration purposes.

Pin 9 — +5VDC System Power Input: The meter requires regulated (±10%) 5VDC power at approximately 200mA, depending on the display brightness.

Pin 10 — Polarity Sign Enable: Connect Pin 10 to Power Ground Input Pin L (or apply logic "0") to display plus and minus polarity signs. Leave open (or apply logic "1") to blank.

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